Attachment A

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translation

SCANDINAVIAN PULP, PAPER AND BOARD
TESTING COMMITTEE

SCAN-C19:65

Accepted - October 1964
Identical with SCAN-M3:65

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DRAINABILITY OF PULP BY THE SCHOPPER-RIEGLER METHOD

Definition

The Schopper-Riegler (SR) number of a pulp is a measure of the drainability of a suspension of pulp in water, determined and expressed as specified in this method.

Scope

This method is applicable to any kind of pulp with the limitations indicated in Note 1.

Principle

A known volume of pulp in aqueous suspension is drained through the fibre mat, formed on a wire screen during the test, into a funnel provided with a bottom and a side orifice (*Figure* 1). The filtrate collected from the side orifice is measured in a special cylinder, graduated in SR units. A discharge of 1000 ml corresponds to zero SR units, and zero discharge to 100 SR units. One SR unit thus corresponds to 10 ml.

Apparatus

1. Schopper-Riegler apparatus of the design and in the condition specified in Appendices A and B, respectively.
2. Measuring cylinder graduated in SR units (Appendix A).

Preparation of sample

Disintegrate a sample of mechanical pulp as described in SCAN-M 2 and of chemical pulp as described in SCAN-C 18 and dilute the suspension so obtained to approximately 2.2 g per litre. Determine the stock concentration by the procedure in SCAN-M 1 or SCAN-C 17. Avoid the formation of air bubbles in the suspension. Dilute the pulp suspension to 2.00 g ± 0.02 g of oven-dry pulp per litre and adjust its temperature to 20.0° C ± 0.5° C. Throughout the test use distilled, deionized or otherwise purified water that gives results equivalent to those obtained with distilled water (Note 2).

Procedure

Clean the funnel and drainage chamber of the apparatus thoroughly, rinse finally with water and place the drainage chamber in the seat of the funnel. Adjust the temperature of the apparatus by rinsing it with water at 20.0° C ± 0.5° C. Place the sealing cone in the closed position and place the SR-measuring cylinder beneath the side orifice. While stirring, transfer 1000 ml ± 5 ml of homogeneous pulp suspension to a measuring cylinder. Agitate the pulp suspension in the cylinder and pour it rapidly but smoothly into the drainage chamber. Direct the stream against the shaft and the wings of the sealing cone to avoid a vortex. Raise the sealing cone 5 s after all the pulp suspension has been added. Read the SR number to the nearest unit when no more water drips from the side orifice.

Make two determinations on each sample. The results should not differ by more than 4 %. If they do, make another pair of determinations. The number of determinations to be performed may also be calculated as described in SCAN-G 2, Section: "Number of observations."

Report

For each sample report the mean SR number to the nearest unit. If the sample was received in slush form, state the concentration and the origin of the water used to form the slurry.

If water other than that specified above is used for the test, this fact must be stated with the test results (Note 2).

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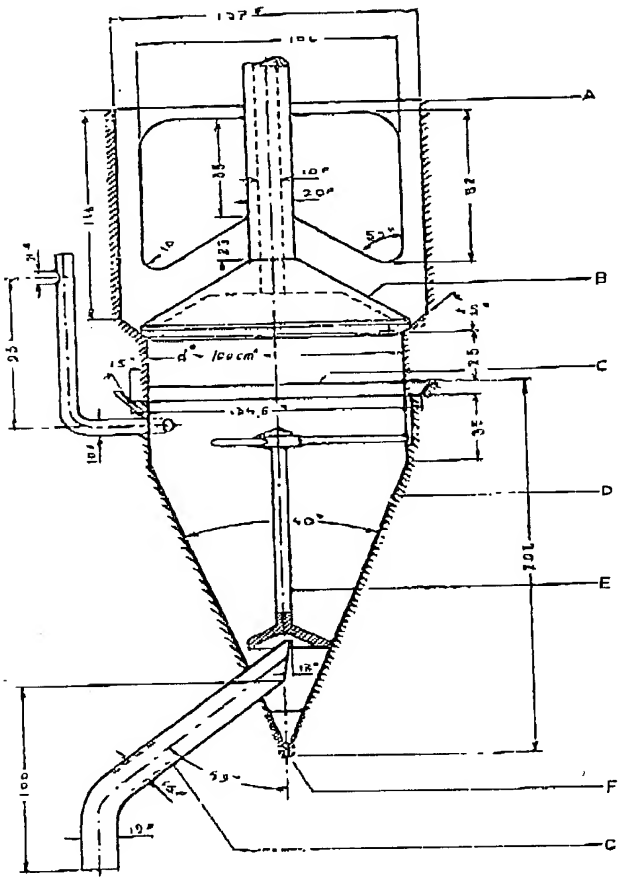


Figure 1 Schopper-Riegler apparatus.

A = drainage chamber
B = sealing cone
C = wire screen
D = funnel
E = spreader cone
F = bottom orifice
G = side orifice

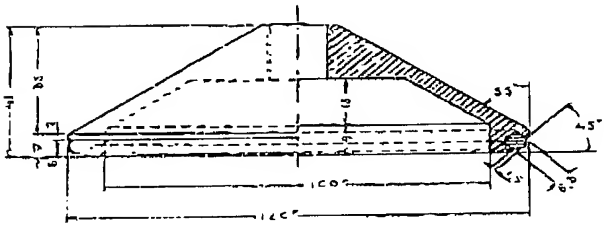


Figure 2. Sealing cone.

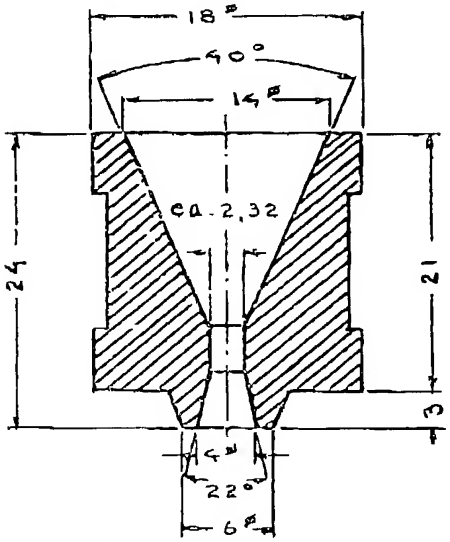
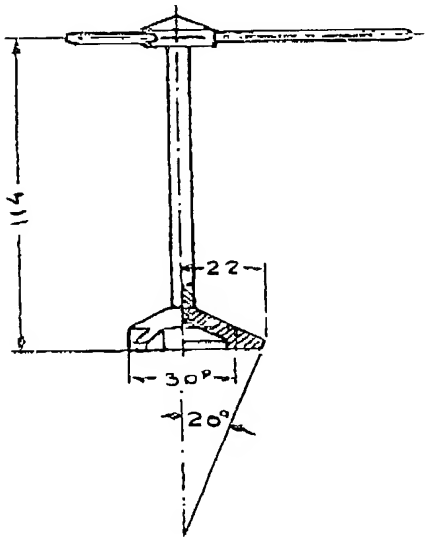


Figure 3 Bottom orifice.



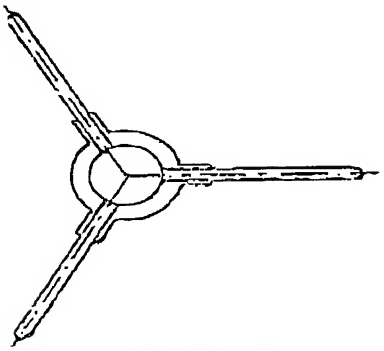


Figure 4. Spreader cone.

Additional information

This method is based on the German Standard method "Merkblatt V/7/61".

Note 1

The Schopper-Riegler test gives acceptable results only if a sufficiently dense mat of fibres is formed on the wire screen. For this reason the test is not recommended for very short-fibred pulps such as those from well beaten hardwood, as most of the fibres may pass through the wire screen and low SR numbers will result although the pulp will drain slowly on the paper machine.

The most reliable results are obtained within the SR number range 10—90.

Note 2

As even small amounts of electrolytes affect the drainage rate considerably, the standard method prescribes water as specified above. If other water is used, the results cannot be considered as complying with the standard procedure and the type of the water should be stated with the test results.

APPENDIX A — DESIGN OF THE SCHOPPER-RIEGLER APPARATUS

The SR apparatus (*Figure* 1) consists of a drainage chamber furnished with a wire screen, a sealing cone and a funnel mounted on a suitable support. All parts are made of non-corroding material.

The drainage chamber is a cylinder with an inside diameter of 137 mm and, at the lower end, a 45° tapering section followed by a cylindrical part with a diameter of 112.9 mm ± 0.1 mm (cross sectional area 100 cm²). The tapering section forms a seating for the sealing cone. The wire screen is made of phosphor bronze and fits tightly into the cylinder 25 mm below the taper. It is plane and is mounted perpendicularly to the cylinder axis, 0.40 mm thick, and has 24 weft and 32 warp meshes per centimetre. The weft strands are 0.17 mm and warp strands 0.16 mm thick.

The sealing cone (*Figure* 2) has an outside diameter of 120 mm and its tapered surface is 55° to the vertical. The sealing cone is fitted to a vertical shaft with an outside diameter of 20 mm. Axially through the sealing cone and the shaft runs a vent with a diameter of 10 mm, which permits the passage of air when the sealing cone is raised. The shaft is provided with two wings diametrically and vertically placed to prevent vortices in the pulp suspension. The seal consists of a rubber ring of 30° Shore hardness. The sealing cone shall be raised at a constant rate of 10 cm/s ± 1 cm/s.

The funnel has an upper conical section, which provides a seating for the drainage chamber and enables the sealing cone to be centered accurately in the chamber. This conical section is followed by a cylindrical section with a cross sectional area of 100 cm² and a height of 35 mm. Near the top of this section there is a vent for equalizing the air pressure. The cylindrical section has three grooves, which fix the location of the spreader cone. The lower part of the funnel is conical with a cone angle of 90.0° and terminates in a separate bottom orifice made of monel metal and with the dimensions given in *Figure* 3. The diameter of the cylindrical section of the bottom orifice is chosen so that 1000 ml of water at 20.0° C ± 0.5° C poured into the funnel drains out in 149 s ± 1 s. This necessitates a diameter of about 2.32 mm (Appendix B).

The side orifice has an inside diameter of 16.0 mm ± 0.1 mm and an outside diameter of 19.0 mm ± 0.1 mm. It penetrates the funnel at 49.0° to the vertical. The upper end of the side orifice is cut at 12.0° to the central axis of the funnel and the overflow edge is as near as possible to the centre of the funnel. In this position the volume between the lower edge of the bottom orifice and the overflow edge of the side orifice is 7.5 ml—8.0 ml. The level of the overflow edge is adjustable. A detachable spreader cone is placed in the funnel to prevent splash from entering the side orifice (*Figure* 4). One of the supporting legs of the spreader cone is placed diametrically to the side orifice.

Measuring cylinder

The measuring cylinder is graduated to give a direct reading of the Schopper-Riegler number, so that a volume of 1000 ml corresponds to zero SR units and a volume of zero ml to 100 SR units. The distance between two graduations should be at least 1.5 mm and corresponds to a volume of 10 ml or one SR unit.

APPENDIX B — CHECKING OF THE SCHOPPER-RIEGLER APPARATUS

The SR apparatus should be checked regularly as follows:

1. Check that the apparatus is properly levelled so that the wire screen is horizontal.
2. Check with a feeler gauge that the gasket on the wire screen fits tightly against the screen so that the effective drainage area is 100 cm².
3. Check that the sealing ring is in good condition. Check also by pouring water into the drainage chamber that the sealing cone fits tightly.
4. Check that the spparatus is clean and free from pitch deposits. If necessary, clean with soap and rinse thoroughly with water. Special attention should be paid to the wire screen. To check that the wire screen is clean, measure the Schopper-

Riegler number for pure water. A value of more than 4 shows that the wire screen needs cleaning. If necessary, clean the screen with acetone and a soft brush and rinse is generously with water. Replace a wire screen that is not in good condition.

5. Check the position of the side orifice in the following way: Close the bottom orifice with a finger. Pour 100 ml of water at 20° C into the funnel. Wait until the excess has escaped through the side orifice. Open the bottom orifice and collect the water leaving the funnel. The volume of the water shall be 7.5 ml—8.0 ml. If this is not the case, adjust the side orifice. Check that the side orifice is in the right position (Appendix A) so that the pressure head is correct.

6. Check the dimension of the bottom orifice. Remove the spreader cone. Close the side orifice with a stopper and fill it by pouring about half a litre of water at 20° C into the funnel while closing the bottom orifice with a finger. After a moment let out the excess water through the bottom orifice. After closing the bottom orifice again refill the funnel with 1000 ml of water at 20.0° C ± 0.5° C and note the time required for the water to drain through the bottom orifice. The time should be 149 s ± 1 s.
If the time is too long the orifice may be widened by honing it with a suitable tool. If the time is too short, the bottom orifice should be replaced. Bottom orifices calibrated by a laboratory authorized by The Scandinavian Pulp, Paper and Board Testing Committee are available from manufacturers of the Schopper-Riegler apparatus.

7. Check that the sealing cone moves with a constant rate of 10 cm/s ± 1 cm/s.

Literature

1. *Hawan, S.:* Norsk Skogindustri *18* (1964): 2, 60—64. Paperi ja Puu — Papper och Trä *46* (1964):3, 97—103. Svensk Papperstidning 67 (1964):8, 325—328.
2. Verein der Zellstoff- und Papier-Chemiker und -Ingenieure: Merkblatt V/7/61.

This method has been published in:
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Paperi ja Puu — Papper och Trä *47* (1965):2, 67—78. (English, finnish, swedish)
Svensk Papperstidning 68 (1965):5, 155—158. (Swedish)
Svensk Papperstidning 68 (1965):6, 188—191. (English)

SCAN testing methods are issued and recommended by the Central Laboratories of the Pulp, Paper and Board Industries in Denmark, Finland, Norway and Sweden. Distribution: Secretariat, Scandinavian Pulp, Paper and Board Testing Committee, Drottning Kristinas väg 61, Stockholm 6., Sweden.

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Attachment B

SCANDINAVIAN PULP, PAPER AND BOARD
TESTING COMMITTEE

SCAN-C21:65

Accepted - July 1965
Identical with SCAN-M4:65

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DRAINABILITY OF PULP
BY THE CANADIAN FREENESS METHOD

Definition

The Canadian Freeness (CF) number of a pulp is a measure of the drainability of a supspension of pulp in water, determined and expressed as specified in this method.

Scope

This method applies to any kind of pulp with the limitations indicated in Note 1.

Principle

A known volume of pulp in aqueous suspension is drained through the fibre mat, formed on a screen plate during the test, into a funnel provided with a bottom and a side orifice *(Figure* 1). The filtrate collected from the side orifice is measured in a cylinder, graduated in millilitres. The volume of the filtrate, in millilitres, is the Canadian Freeness number of the pulp.

Apparatus

Canadian Freeness tester of the design and in the condition specified in Appendices A and B.

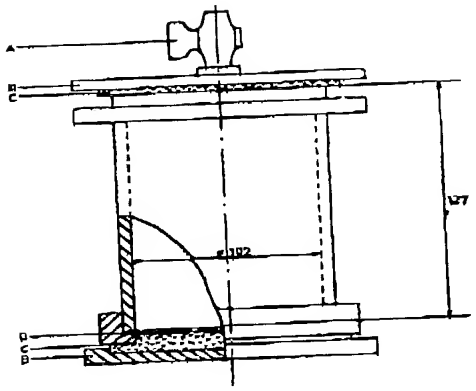
Preparation of sample

Disintegrate a sample of mechanical pulp as described in SCAN-M 2 and of chemical pulp as described in SCAN-C 18 and dilute the suspension so obtained to approximately 3.2 g per litre. Determine the stock concentration by the procedure in SCAN-M 1 or SCAN-C 17. Avoid the formation of air bubbles in the suspension. Dilute the pulp suspension to 3.00 g ± 0.02 g of oven-dry pulp per litre and adjust its temperature to 20.0°C ± 0.5°C. Throughout the test use distilled, deionized or otherwise purified water that gives results equivalent to those obtained with distilled water (*Note* 2).

Procedure

Clean the funnel and drainage chamber of the apparatus thoroughly, rinse finally with water and place the drainage chamber in the upper bracket. Adjust the temperature of the apparatus by rinsing it with water at 20.0°C ± 0.5°C. Check that the spreader cone is placed in the grooves in the funnel. Close the bottom lid of the drainage chamber and open the top lid and the air-cock. Place a graduated measuring cylinder beneath the side orifice. While stirring, transfer 1000 ml ± 5 ml of homogenous pulp suspension to a measuring cylinder. Agitate the pulp suspension in the cylinder and pour it rapidly but smoothly into the drainage chamber. Close the top lid and the air-cock. Open the bottom lid. Open the air-cock 5 s after all the pulp suspension has been added. When no more water drips from the side orifice read the volume with the accuracy prescribed in "Report".

Make two determinations on each sample. The results should not differ by more than 4 %. If they do, make another pair of determinations. The number of determinations to be performed may also be calculated as described in SCAN-G 2, Section: "Number of observations".



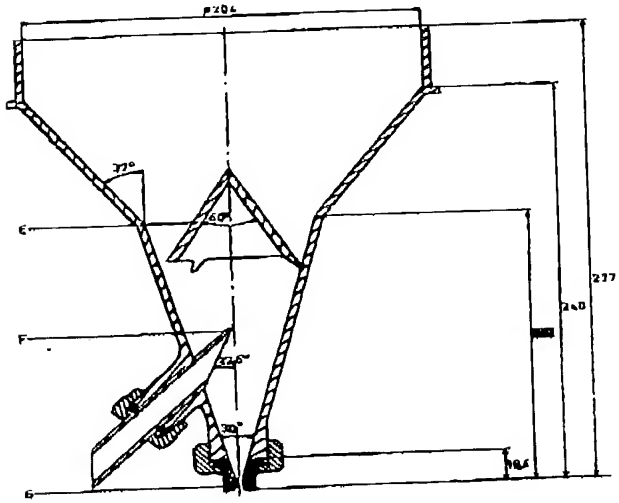


Figure 1.

Draining chamber and funnel

A. Air-cock
B. Lids
C. Rubber gaskets
D. Screen plate
E. Spreader cone
F. Side orifice
G. Bottom orifice

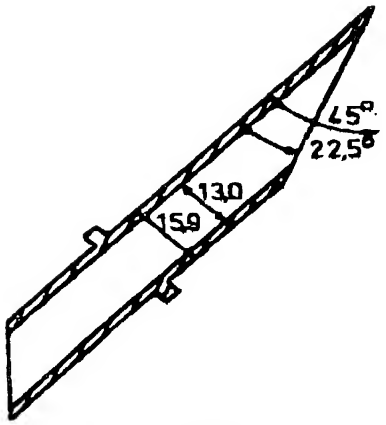


Figure 2.

Side orifice

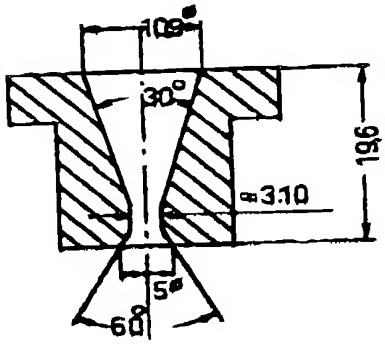


Figure 3.

Bottom orifice

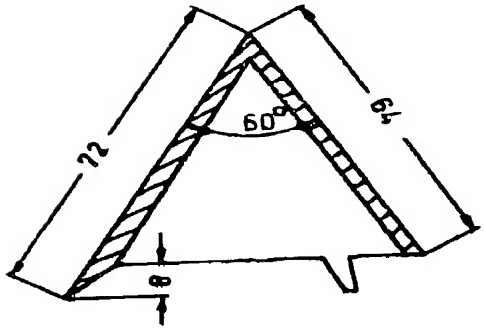


Figure 4.

Spreader cone

Report

For each sample report the mean CF number. Read to the nearest 1 ml for values less than 100 ml, to the nearest 2 ml for values between 100 and 250 ml and to the nearest 5 ml for values over 250 ml. If the sample was received in slush form, state the concentration and the origin of the water used to form the slurry.
If water other than that specified above is used for the test, this fact must be stated with the test results (Note 2).

Additional information

This method is based on the Canadian Standard method CPPA C1 : 62 and should give equivalent results.

Note 1

The Canadian Freeness test gives acceptable results only if a sufficiently dense mat of fibres is formed on the screen plate. For this reason the test is not recommended for very short-fibred pulps such as those from well beaten hardwood, as most of the fibres may pass through the screen plate, and high CF numbers will result although the pulp will drain slowly on the paper machine.
The most reliable results are obtained within the CF number range 30—850.

Note 2

As even small amounts of electrolytes affect the drainage rate considerably, the standard method prescribes water as specified above. If other water is used, the results can not be considered as complying with the standard procedure and the type of water should be stated with the test results.

APPENDIX A — DESIGN OF THE DRAINABILITY TESTER

The tester (Figure 1) consists of a drainage chamber provided with a screen plate, and a funnel, both mounted on a suitable support. All parts are made of non-corroding material.

The drainage chamber is a cylinder, open at the top and fitted with a perforated screen plate at the bottom. It shall be closed by means of lids at top and bottom. The bottom lid is covered with a rubber gasket for sealing against the screen plate and a flange around the lower edge of the cylinder. The top lid has a soft rubber gasket so that the chamber can be closed air-tight and in the centre of the lid is inserted an air-cock to admit air to the cylinder at the start of the test. The cylinder has an inside diameter of 102.0 mm ± 0.1 mm and a height of 127.0 mm ± 0.1 mm from the upper surface of the screen plate to the upper edge of the cylinder. These dimensions give the cylinder a volume of slightly over 1000 ml above the screen plate. The air-cock bore is 4.8 mm ± 0.1 mm. The screen plate has a thickness of 0.5 mm and perforations of 0.5 mm diameter. The perforations are evenly distributed over the surface and the number of holes are 97 per cm². The screen plate shall be placed with the burrs downwards. It is calibrated against a SCAN-test master screen plate as described in Appendix B.

The funnel has an upper inside diameter of 204 mm and a total length of 277 mm. The funnel, whose lower cone angle is 90°, has three grooves for fixed location of the spreader cone. All other dimensions are specified in Figure 1.

The side orifice has an inside diameter of 13.0 mm ± 0.1 mm and an outside diameter of 15.9 mm ± 0.1 mm, *Figure* 2. It penetrates the funnel at an angle of 45° to the vertical. The upper end of the side orifice tube is cut at an angle of 22.5° to the centre line of the funnel and the upper edge is so near as possible to the centre line of the funnel. In this position the volume between the lower edge of the bottom orifice and the overflow edge of the side orifice is 24.2 ml ± 0.2 ml. The level of the overflow edge is adjustable.

The bottom orifice *(Figure* 3) has a length of 19.6 mm and such a diameter that 530 ml/min ± 5 ml/min of water at 20.0°C ± 0.5°C leaves the funnel when enough water enters it to maintain a moderate overflow of the excess through the side orifice. This corresponds to a diameter of approximately 3.10 mm. The orifice cones out at the bottom to minimize the effect of damages. Bottom orifice and funnel are concentric and the two pieces fit accurately with flush inside surfaces. A detachable spreader cone is placed in the funnel to prevent splash from entering the side orifice *(Figure* 4). One of the three supports is placed diametrically to the side orifice.

APPENDIX B — CHECKING OF THE DRAINABILITY TESTER

The tester should be checked regularly as follows:

1. Check that the apparatus is properly levelled so that the screen plate is horizontal.
2. Check that the apparatus is clean and free from pitch accumulations. If necessary, clean with soap and rinse with water.
3. Check that the rubber gasket in the lower lid of the drainage chamber is in perfect condition so that no leakage occurs when water is poured into the chamber.
4. Check that the rubber gasket of the upper lid of the drainage chamber is flawless, well cleaned and elastic so that not more than 0.5 ml of water flows through the screen plate when the lower lid is opened, the upper lid and air-cock being closed.